

What is claimed is:

1. An apparatus for measuring an amount of oil in a flow of fluid, the apparatus comprising:

- 5 a housing having an interior passage configured to have a flow of fluid pass therethrough, the housing having a receiving end coupled with an output of a source of the flow of fluid and an output end coupled with a fluid destination;
- 10 a magnetic source disposed inside the interior passage, the magnetic source being positioned such that a magnetic field producible by the magnetic source is configured to induce an electric current in a conductive portion of the flow of fluid as the flow of fluid passes from the receiving end of the housing to the output end of the housing; and
- 15 a detector disposed inside the interior passage between the magnetic source and the output end of the housing, the detector being configured to respond to the electric current induced in the conductive portion of the flow of fluid and generate a first signal representative of an amount of oil the flow of fluid.

2. The apparatus of Claim 1, wherein the housing includes a first end coupled with an outlet of a source of the flow of fluid and a second end.

3. The apparatus of Claim 2, wherein the first and second ends of the housing include flanges such that the flanges are coupleable with flanged pipe sections.

20 4. The apparatus of Claim 1, wherein the housing includes one of a steel pipe, an iron pipe, a copper pipe, an opaque PVC pipe, a translucent PVC pipe, or a clear PVC pipe.

5. The apparatus of Claim 1, further comprising an analog-to-digital converting circuit configured to convert the first signal into a first digital signal.

25 6. The apparatus of Claim 5, further comprising an interface configured to communicate the first digital signal.

7. The apparatus of Claim 6, wherein the interface includes an RS-232 interface.

8. The apparatus of Claim 6, further comprising a first telemetry module configured to receive the first digital signal from the interface and to communicate the first digital signal to a data collection device.



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9. The apparatus of Claim 5, further comprising a computing module configured to receive the first digital signal and compute a relative amount of oil in the flow of fluid, the computing module being further configured to generate a second signal indicative of the relative amount of oil in the flow of fluid.

5 10. The apparatus of Claim 9, further comprising a second telemetry module configured to communicate the second signal to the data collection device.

11. The apparatus of Claim 9, further comprising a flow rate sensor disposed on the interior passage of the housing, the flow rate sensor being configured to measure a total rate of the flow of fluid passing through the interior passage of the housing and to generate a third  
10 signal indicative of the total rate of flow of fluid.

12. The apparatus of Claim 11, wherein the computing module is further configured to combine the second signal with the third signal for calculating a total flow rate of oil in the flow of fluid, the computing module being further configured to generate a fourth signal indicative of the total flow rate of oil.

15 13. The apparatus of Claim 12, further comprising a third telemetry module configured to communicate the fourth signal to the data collection device.

14. The apparatus of Claim 12, further comprising at least one additional fluid property sensor disposed on the interior passage of the housing, the at least one additional fluid property sensor being configured to measure an additional fluid property of the flow of fluid  
20 passing through interior passage of the housing and generate a fifth signal.

15. The apparatus of Claim 14, wherein the computing module is further configured to combine the fifth signal with the fourth signal for calculating an adjusted total flow rate of oil in the flow of fluid, the computing module being further configured to generate a sixth signal indicative of the adjusted total flow rate of oil.

25 16. The apparatus of Claim 15, further comprising a fourth telemetry module configured to communicate the adjusted amount of oil signal to the data collection device.

17. The apparatus of Claim 15, wherein the at least one additional fluid property sensor includes at least one pressure sensor configured to measure a pressure of the flow of fluid passing through the interior passage of the housing.



18. The apparatus of Claim 15, wherein the at least one additional fluid property sensor includes a density sensor configured to measure a density of the flow of fluid passing through the interior passage of the housing.

5 19. The apparatus of Claim 18, wherein the density sensor includes a nuclear density sensor.

20. The apparatus of Claim 15, wherein the at least one additional fluid property sensor includes a temperature sensor configured to measure a temperature of the flow of fluid passing through the interior passage of the housing.

10 21. The apparatus of Claim 2, further comprising a gas separator coupled between the first end of the housing and the source of the flow of fluid, the gas separator being configured to allow separation of gas from the flow of fluid.

22. A system for measuring an amount of oil in a flow of fluid, the system comprising:  
15 a housing having an interior passage configured to have a flow of fluid pass therethrough, the housing having a receiving end coupled with an output of a source of the flow of fluid and an output end coupled with a fluid destination;  
a magnetic source disposed inside the interior passage, the magnetic source being positioned such that a magnetic field producible by the magnetic source is configured to induce an electric current in a conductive portion of the flow of fluid as the flow of fluid passes from the receiving end of the housing to the  
20 output end of the housing;  
a detector disposed inside the interior passage between the magnetic source and the output end of the housing, the detector being configured to respond to the electric current induced in the conductive portion of the flow of fluid and generate a first signal representative of an amount of oil the flow of fluid;  
25 an analog-to-digital converting circuit configured to convert the first signal into a first digital signal;  
a computing module configured to receive the first digital signal and compute a relative amount of oil in the flow of fluid, the computing module being further configured to generate a second signal representative of the relative amount of  
30 oil; and  
an interface configured to communicate the second signal.



23. The system of Claim 22, wherein the housing includes a first end coupled with an outlet of a source of the flow of fluid and a second end.

24. The system of Claim 23, wherein the first and second ends of the housing include flanges such that the flanges are coupleable with flanged pipe sections.

5 25. The system of Claim 22, wherein the housing includes one of a steel pipe, an iron pipe, a copper pipe, an opaque PVC pipe, a translucent PVC pipe, or a clear PVC pipe.

26. The system of Claim 22, wherein the interface includes an RS-232 interface.

27. The system of Claim 22, further comprising a first telemetry module configured to receive the first digital signal from the interface and to communicate the second signal to a data collection device.

28. The system of Claim 22, further comprising a flow rate sensor disposed on the interior passage of the housing, the flow rate sensor being configured to measure a total rate of the flow of fluid passing through the interior passage of the housing and to generate third signal indicative of the total rate of the flow of fluid.

15 29. The system of Claim 28, wherein the computing module is further configured to combine the second signal with the third signal for calculating a total flow rate of oil in the flow of fluid, the computing module being further configured to generate a fourth signal indicative of the total flow rate of oil.

20 30. The system of Claim 29, further comprising a second telemetry module configured to communicate the fourth signal to the data collection device.

31. The system of Claim 29, further comprising at least one additional fluid property sensor disposed on the interior passage of the housing, the at least one additional fluid property sensor being configured to measure an additional fluid property of the flow of fluid passing through interior passage of the housing and generate a fifth signal representative of the additional fluid property.

32. The system of Claim 21, wherein the computing module is further configured to combine the fifth signal with the fourth signal for calculating an adjusted total flow rate of oil in the flow of fluid, the computing module being further configured to generate a sixth signal representative of the adjusted total flow rate of oil.



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33. The system of Claim 22, further comprising a third telemetry module configured to communicate the sixth signal to the data collection device.

34. The system of Claim 21, wherein the at least one additional fluid property sensor includes at least one pressure sensor configured to measure a pressure of the flow of fluid passing through the interior passage of the housing.

35. The system of Claim 21, wherein the at least one additional fluid property sensor includes a density sensor configured to measure a density of the flow of fluid passing through the interior passage of the housing.

36. The system of Claim 25, wherein the density sensor includes a nuclear density sensor.

37. The system of Claim 21, wherein the at least one additional fluid property sensor includes a temperature sensor configured to measure a temperature of the flow of fluid passing through the interior passage of the housing.

38. The system of Claim 23, further comprising a gas separator coupled between the first end of the housing and the source of the flow of fluid, the gas separator being configured to allow separation of gas from the flow of fluid.

39. A system for measuring an amount of oil in a flow of fluid, the system comprising:  
a housing having an interior passage configured to have a flow of fluid pass therethrough, the housing having a receiving end coupled with an output of a source of the flow of fluid and an output end coupled with a fluid destination;  
a magnetic source disposed inside the interior passage, the magnetic source being positioned such that a magnetic field producible by the magnetic source is configured to induce an electric current in a conductive portion of the flow of fluid as the flow of fluid passes from the receiving end of the housing to the output end of the housing;  
a detector disposed inside the interior passage between the magnetic source and the output end of the housing, the detector being configured to respond to the electric current induced in the conductive portion of the flow of fluid and generate a first signal representative of an amount of oil the flow of fluid.;  
a flow rate sensor disposed on the interior passage of the housing, the flow rate sensor being configured to measure a total rate of the flow of fluid passing

through the interior passage of the housing and to generate a second signal representative of the total rate of the flow of fluid;  
an analog-to-digital converting circuit configured to convert the first signal into a first digital signal;  
5 a computing module configured to receive the first digital signal and compute a relative amount of oil in the flow of fluid, the computing module being further configured to generate a third signal representative of the relative amount of oil, the computing module being further configured to combine the second signal and the third signal for calculating a total flow rate of oil in the flow of  
10 fluid, the computing module being further configured to generate a fourth signal representative of the total flow rate of oil; and  
an interface configured to communicate the fourth digital signal.

40. The system of Claim 29, wherein the housing includes a first end coupled with an outlet of a source of the flow of fluid and a second end.

15 41. The system of Claim 40, wherein the first and second ends of the housing include flanges such that the flanges are coupleable with flanged pipe sections.

42. The system of Claim 29, wherein the housing includes one of a steel pipe, an iron pipe, a copper pipe, an opaque PVC pipe, a translucent PVC pipe, or a clear PVC pipe.

43. The system of Claim 29, wherein the interface includes an RS-232 interface.

20 44. The system of Claim 29, further comprising a first telemetry module configured to communicate the fourth signal to a data collection device.

45. The system of Claim 29, further comprising at least one additional fluid property sensor disposed on the interior passage of the housing, the at least one additional fluid property sensor being configured to measure an additional fluid property of the flow of fluid  
25 passing through interior passage of the housing and generate a fifth signal representative of the fluid property.

46. The system of Claim 45, wherein the computing module is further configured to combine the fifth signal with the fourth signal for calculating an adjusted total flow rate of oil in the flow of fluid, the computing module being further configured to generate a sixth signal  
30 representative of the adjusted total flow rate of oil.



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47. The system of Claim 46, further comprising a second telemetry module configured to communicate the sixth signal to the data collection device.

48. The system of Claim 45, wherein the at least one additional fluid property sensor includes at least one pressure sensor configured to measure a pressure of the flow of fluid passing through the interior passage of the housing.

49. The system of Claim 45, wherein the at least one additional fluid property sensor includes a density sensor configured to measure a density of the flow of fluid passing through the interior passage of the housing.

50. The system of Claim 49, wherein the density sensor includes a nuclear density sensor.

51. The system of Claim 45, wherein the at least one additional fluid property sensor includes a temperature sensor configured to measure a temperature of the flow of fluid passing through the interior passage of the housing.

52. The system of Claim 29, further comprising a gas separator coupled between the first end of the housing and the source of the flow of fluid, the gas separator being configured to allow separation of gas from the flow of fluid.

53. A method for measuring an amount of oil in a flow of fluid, the apparatus comprising:

passing a flow of fluid from a source of fluid through a housing;  
generating a magnetic field in the flow of fluid passing through the housing to induce an electric current in a conductive portion of the flow of fluid;  
measuring the current induced in the conductive portion of the flow of fluid;  
calculating a relative amount of oil in the flow of fluid based on the current induced in the conductive portion of the flow of fluid; and  
generating a first signal representative of a relative amount of oil in the flow of fluid.

54. The method of Claim 53, further comprising communicating the first signal to a data collection device.

55. The method of Claim 53, further comprising measuring a rate of flow of fluid through the housing.



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56. The method of Claim 55, further comprising calculating a total flow rate of oil in the flow of fluid by combining the rate of flow of fluid with the relative amount of oil in the flow of fluid and generating a second signal representative of the total flow rate of oil.

57. The method of Claim 56, further comprising communicating the second signal to the data collection device.

58. The method of Claim 56, further comprising measuring at least one additional fluid property of the flow of fluid passing through the housing.

59. The method of Claim 58, further comprising calculating an adjusted total flow rate of oil in the flow of fluid by combining the total flow rate of oil in the flow of fluid with the additional property of the flow of fluid and generating a third signal.

60. The method of Claim 59, further comprising communicating the third signal to the data collection device.

61. The method of Claim 58, wherein the at least one additional fluid property includes fluid pressure.

62. The method of Claim 58, wherein the at least one additional fluid property includes fluid density.

63. The method of Claim 58, wherein the at least one additional fluid property includes fluid temperature.

64. The method of Claim 53, further comprising separating gas from the flow of fluid before directing the flow of fluid from the source of fluid through the housing.

65. A method for measuring an amount of oil in a flow of fluid, the apparatus comprising:

passing a flow of fluid from a source of fluid through a housing;

generating a magnetic field in the flow of fluid passing through the housing to

induce an electric current in a conductive portion of the flow of fluid;

measuring the current induced in the conductive portion of the flow of fluid;

measuring a rate of flow of fluid through the housing;

calculating a relative amount of oil in the flow of fluid based on the current induced in the conductive portion of the flow of fluid;



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calculating a total flow rate of oil in the flow of fluid by combining the rate of flow of fluid with the relative amount of oil in the flow of fluid; and generating a first signal representative of the total flow rate of oil.

5 66. The method of Claim 65, further comprising communicating the first signal to a data collection device.

67. The method of Claim 65, further comprising measuring at least one additional fluid property of the flow of fluid passing through the housing.

10 68. The method of Claim 67, further comprising calculating an adjusted total flow rate of oil in the flow of fluid by combining the total flow rate of oil in the flow of fluid with the additional property of the flow of fluid and generating a second signal.

69. The method of Claim 68, further comprising communicating the second signal to the data collection device.

70. The method of Claim 67, wherein the at least one additional fluid property includes fluid pressure.

15 71. The method of Claim 67, wherein the at least one additional fluid property includes fluid density.

72. The method of Claim 67, wherein the at least one additional fluid property includes fluid temperature.

20 73. The method of Claim 67, further comprising communicating the adjusted total flow rate of oil in the flow of fluid to the data collection device.

74. The method of Claim 65, further comprising separating gas from the flow of fluid before directing the flow of fluid from the source of fluid through the housing.